COMPARATIVE ANALYSIS OF LOGISTICS MANAGEMENT EFFICIENCY AT BORDER CUSTOMS: EVIDENCE FROM MUKDAHAN AND CHONG MEK CHECKPOINTS IN THAILAND

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ABSTRACT

Purpose: This study examines the impact of inventory management, transportation, and information management on logistics efficiency at two Thai border customs checkpoints, Mukdahan and Chong Mek, with the aim of comparing both determinants and overall performance.
Design/methodology/approach: A quantitative survey was conducted with 125 respondents including exporters, importers, freight forwarders, and transport providers. Data were collected through structured questionnaires and analyzed using descriptive statistics, Pearson correlation, multiple regression, and independent samples t-test, following recent approaches in cross-border logistics studies (Sumbal et al., 2024).
Findings: Overall, all three logistics factors significantly influenced efficiency, with information management showing the strongest effect. At Mukdahan, located on the East–West Economic Corridor (EWEC), IT systems such as e-Customs and the National Single Window were key drivers of efficiency, consistent with evidence that digital adoption reduces bottlenecks (Zdolsek Draksler et al., 2023; Nguyen et al., 2024). At Chong Mek, however, the model was statistically insignificant, suggesting that informal practices and local trade dynamics were more decisive, echoing earlier findings on the role of non-formal mechanisms in border trade (Lesser & Moisé-Leeman, 2009). Unexpectedly, Chong Mek was rated more efficient than Mukdahan, contradicting the hypothesis and highlighting context-specific dynamics.
Research limitations/implications: The study's quantitative design may overlook non-formal determinants; qualitative methods are recommended for future research.
Practical implications: Policymakers should continue IT investment at Mukdahan while focusing on facilitation and basic infrastructure at Chong Mek. Practitioners can use Mukdahan for high-value goods requiring transparency, and Chong Mek for local consumer trade benefiting from flexibility.
Originality/value: The study advances understanding of how formal IT-driven systems and informal practices jointly shape cross-border logistics performance in ASEAN.

Keywords: cross-border logistics, customs efficiency, inventory management, transportation, information management, Thailand

Background and Significance of the Study

Amid the dynamics of a borderless global economy, international trade has become a critical driver of economic growth. Within the ASEAN Economic Community (AEC), which promotes the free flow of goods and services (Department of International Trade Promotion, 2023), Thailand occupies a strategic position in the region. To strengthen its competitiveness, the country must enhance logistics and supply chain systems in terms of cost efficiency, speed, and reliability.

The three fundamental components of logistics—inventory management, transportation, and information management—are widely recognized as key determinants of trade success. This is particularly relevant in the context of cross-border trade and developing economies, where uncertainties in customs procedures and delays in information processing directly increase inventory costs and undermine supply chain performance (Yangailo, 2024; Sumbal et al., 2024). Border customs checkpoints thus serve as strategic nodes where these logistics dimensions must operate effectively. Yangailo (2024) highlights that border efficiency directly impacts international trade in both economic and temporal dimensions.

Mukdahan and Ubon Ratchathani provinces illustrate contrasting cases of border development. Mukdahan, located along the East–West Economic Corridor (EWEC), has benefited from investments in infrastructure such as the Friendship Bridge and modernized customs information systems, enabling efficient cross-border data management and bonded warehouse operations (Sumbal et al., 2024). In

contrast, the Chong Mek checkpoint, linking Thailand with Champasak Province in Lao PDR, reflects traditional local border trade with strong cultural and local economic significance, yet lacks comparable infrastructure and IT integration.

These differences raise an important academic question: how do inventory management, transportation, and information management influence overall logistics performance across distinct border contexts? Addressing this question not only highlights the strengths and weaknesses of each checkpoint but also generates knowledge that can inform sustainable policy design and the development of competitive border logistics systems.

Research Objectives

1. To compare the influence of three logistics management dimensions—inventory management, transportation, and information management—on the overall performance of the logistics system between Chong Mek and Mukdahan customs checkpoints.
2. To compare the level of logistics system performance between Chong Mek and Mukdahan customs checkpoints.

Literature Review and Theoretical Background

Logistics and supply chain management play a critical role in enhancing national competitiveness, particularly in cross-border trade where domestic and international markets intersect. The Council of Supply Chain Management Professionals (CSCMP) defines logistics as the planning, implementation, and control of the flow of goods, services, and related information from origin to consumption, aiming to maximize efficiency at minimal cost (Abeng, 2022). Christopher (2016) further emphasizes agility and responsiveness to rapidly changing market demands as determinants of competitive advantage.

Prior studies highlight three logistics dimensions as central to border operations: inventory management, transportation, and information management. Inefficiencies in customs clearance and information processing have been shown to increase inventory costs and delay supply chain flows (Yangailo, 2024; Zdolsek Draksler et al., 2023; Sumbal et al., 2024). Real- time information systems can reduce bottlenecks and enhance transparency in border logistics (Zdolsek Draksler et al., 2023), while transport infrastructure, including multi-modal corridors, directly improves cross-border efficiency (Sumbal et al., 2024). Moreover, inventory agility, often measured by turnover and order lead time, is essential for responsiveness in bonded warehouses and free-trade contexts (Chakma, 2024).

In the ASEAN region, cross-border road transport remains dominant, supported by initiatives such as the Greater Mekong Subregion Cross-Border Transport Agreement (GMS- CBTA), which facilitates the seamless and secure movement of goods across borders (Sumbal et al., 2024). Meanwhile, systems such as Thailand's National Single Window (NSW) and e- Customs provide clear examples of how digital platforms can improve customs efficiency and overall border performance (Zdolsek Draksler et al., 2023). Logistics performance is typically assessed by time, cost, and reliability indicators, with reliability—particularly the predictability of transport—emerging as a key factor for user confidence Sohaimi & Ishak, 2024).

Despite these insights, most existing research either focuses on individual logistics dimensions—such as transport infrastructure or IT adoption—or relies on macro-level indices of supply chain performance. Limited empirical work has systematically compared how these three dimensions jointly influence logistics efficiency at specific border checkpoints. This research gap is particularly significant in emerging economies, where local trade practices, informal arrangements, and uneven infrastructure development may shape efficiency outcomes in ways not captured by conventional models (Lesser & Moisé-Leeman, 2009; Sohaimi & Ishak, 2024). Addressing this gap, the present study compares two contrasting Thai border checkpoints—Mukdahan, positioned on the modern East–West Economic Corridor, and Chong Mek, a traditional local trade hub—thereby contributing to a more nuanced understanding of cross-border logistics performance in the ASEAN context.

4. Conceptual Framework

This study hypothesizes that logistics management practices in three key dimensions— inventory management (X1), transportation management (X2), and information management (X3)—have a direct influence on the overall efficiency of logistics system management (Y). A comparative perspective is adopted between two customs checkpoints. The framework is grounded in prior literature that highlights the positive relationship between logistics management practices and system performance (Sumbal et al., 2024; Chakma, 2024).

Research Hypotheses

1) H1: Logistics management in terms of inventory management (X1) has a positive relationship with logistics system efficiency (Y).
2) H2: Logistics management in terms of transportation management (X2) has a positive relationship with logistics system efficiency (Y).
3) H3: Logistics management in terms of information management (X3) has a positive relationship with logistics system efficiency (Y).
4) H4: The efficiency of logistics system management (Y) at Mukdahan Customs House is significantly higher than that at Chong Mek Customs House.

5. Research Methodology

This study employed a quantitative survey design to investigate logistics management efficiency at the Mukdahan and Chong Mek customs checkpoints. Data were collected from exporters, importers, customs brokers, and freight service providers using structured questionnaires, which have been recognized as effective tools for capturing system-level influences in logistics research. The sample size was determined using Cochran's (1977) formula, with purposive and snowball sampling applied to reach directly relevant participants and expand the respondent base.

The questionnaire, developed from prior literature, consisted of three sections: demographic information, assessments of logistics management practices (inventory, transportation, information), and evaluations of logistics system efficiency (time, cost, reliability). Items were measured on a five-point Likert scale. Content validity was verified through expert review (IOC ≥ 0.50), and reliability testing with a pilot sample (n = 30) produced Cronbach's Alpha values above 0.70, confirming acceptable internal consistency.

Data collection was conducted onsite and online, and the responses were analyzed using descriptive statistics and inferential techniques. Multiple regression was used to examine the influence of inventory, transportation, and information management on logistics efficiency, while independent samples t-tests compared performance between the two checkpoints. These methods have been widely applied in cross-border logistics performance studies (Sumbal et al., 2024).

5.1 Descriptive Analysis of Basic Data

The descriptive analysis of 125 respondents revealed that logistics efficiency was rated high overall (Mean = 3.729), with Chong Mek Customs House outperforming Mukdahan (Means = 3.942 vs. 3.618). Inventory management received the highest overall rating, followed by transportation and information management, with Chong Mek showing consistently higher scores across all three dimensions. These findings suggest that, despite less advanced infrastructure compared to Mukdahan, Chong Mek benefits from local trade dynamics, greater operational flexibility, and informal practices that facilitate faster cross-border processes (Sohaimi & Ishak, 2024; Lesser & Moisé-Leeman, 2009), as shown in Table 1.

Table 1 Mean and Standard Deviation of the Studied Variables

Variables	Overall			Mukdahan Customs House			Chong Mek Customs House		
	Mean	S.D.	Level	Mean	S.D.	Level	Mean	S.D.	Level
Logistics Management Efficiency	3.729	0.429	High	3.618	0.425	High	3.942	0.354	High
Inventory Management	3.936	0.451	High	3.774	0.407	High	4.246	0.364	Very High
Transportation Management	3.907	0.403	High	3.780	0.402	High	4.150	0.277	High
Information Management	3.726	0.472	High	3.571	0.479	High	4.020	0.283	High

5.2 Correlation Analysis

To examine the preliminary relationships between the independent and dependent variables, Pearson's correlation coefficients were calculated, as shown in Table 2. Table 2

Correlation Coefficients among Variables

Variables	Logistics Management Efficiency	Inventory Management	Transportation Management	Information Management
Logistics Management Efficiency	1.000	.511**	.494**	.589**
Inventory Management		1.000	.521**	.445**
Transportation Management			1.000	.384**
Information Management				1.000

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2- tailed).

The results indicated that all independent variables were positively and significantly correlated with logistics management efficiency at the 0.01 level. Among them, information management exhibited the strongest correlation (r = .589), followed by inventory management (r = .511) and transportation management (r = .494), respectively. Furthermore, the correlations among the independent variables themselves were all below 0.70, suggesting that multicollinearity was unlikely to be a concern in subsequent regression analyses.

5.3 Multiple Regression Analysis for Hypothesis Testing

The multiple regression analysis examining the influence of independent variables on overall logistics management efficiency is summarized in Table 3.

Table 3. Results of Multiple Regression Analysis (Overall Sample)

Variables	B	Beta (β)	t-test	Sig.	VIF
(Constant)	.609		1.904	.059	
Inventory Management	.201	.211	2.568*	.011	1.520
Transportation Management	.242	.227	2.849**	.005	1.430
Information Management	.371	.408	5.355**	.000	1.299
R= .679, R Square = .461, Adjusted R Square = .447, F = 34.438**, Sig. = .000					

Note: ** $p < 0.01$, * $p < 0.05$

The overall model was statistically significant, with $F = 34.438$ and $p < 0.001$, indicating that the regression equation was appropriate and predictive. The multiple correlation coefficient (R) was 0.679, suggesting a strong relationship between the independent and dependent variables. The coefficient of determination (R^2) was 0.461, meaning that inventory management, transportation management, and information management collectively explained 46.1% of the variance in logistics efficiency.
The hypothesis testing results were as follows:

- Inventory management exerted a positive and statistically significant effect on logistics efficiency ($B = 0.201$, $p = 0.011$), thus supporting H1.
- Transportation management had a positive and statistically significant effect on logistics efficiency ($B = 0.242$, $p = 0.005$), thus supporting H2.
- Information management demonstrated a positive and highly significant effect on logistics efficiency ($B = 0.371$, $p < 0.001$), thus supporting H3.

When comparing standardized coefficients (Beta), information management emerged as the most influential factor (β = 0.408), followed by transportation management (β = 0.227) and inventory management (β = 0.211). Furthermore, all Variance Inflation Factor (VIF) values ranged between 1.299 and 1.520, confirming that multicollinearity was not a concern in the model.
The analysis of 82 respondents using the Mukdahan border checkpoint is summarized in Table 4.

Table 4 Results of Multiple Regression Analysis at Mukdahan Customs Checkpoint

Variables	B	Beta (β)	t-test	Sig.	VIF
(Constant)	.312		.775	.441	
Inventory Management	.244	.234	2.453*	.016	1.375
Transportation Management	.273	.258	2.823**	.006	1.265
Information Management	.379	.427	4.866**	.000	1.168
R= .697, R Square = .486, Adjusted R Square = .466, F = 24.544, Sig. = .000					

Note: ** p < 0.01, * p < 0.05

Results indicated that the three independent variables—inventory management, transportation management, and information management—jointly explained 48.6% of the variance in logistics management efficiency at this checkpoint ($R^2 = 0.486$). The overall regression model was statistically significant and appropriate for prediction ($F = 24.544$, $p < 0.001$).

All three factors demonstrated positive and statistically significant effects on logistics efficiency at the 0.05 level. Among them, information management exerted the strongest influence (β = 0.427, $p < 0.001$), followed by transportation management (β = 0.258, $p = 0.006$), and inventory management, which had the smallest yet still significant effect (β = 0.234, $p = 0.016$). These findings highlight that for Mukdahan—an advanced checkpoint situated on a major economic corridor—the deployment of information technology to facilitate and expedite customs procedures is the most critical driver of efficiency, complemented by the quality of transportation systems.

The analysis of 43 respondents who utilized the Chong Mek customs checkpoint, as summarized in Table 5, revealed that the regression model for this checkpoint was not statistically significant ($F = 1.739$, $p = .175$). The coefficient of determination ($R^2 = 0.118$) indicated that the three independent variables collectively explained only 11.8% of the variance in logistics efficiency, which is relatively low. This suggests that the model was not suitable for predicting efficiency outcomes at Chong Mek. Moreover, none of the independent variables demonstrated a statistically significant influence on logistics efficiency, as all p- values exceeded the 0.05 threshold. These findings imply that, although respondents rated the factors at relatively high levels, they did not adequately explain or predict variations in efficiency at this checkpoint. This outcome points to the potential influence of other unmodeled factors, such as personal relationships or informal regulatory practices, which may play a more decisive role in shaping efficiency at Chong Mek.

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Table 5 Results of Multiple Regression Analysis at Chong Mek Customs Checkpoint

Variables	B	Beta (β)	t-test	Sig.	VIF
(Constant)	1.444		1.275	.210	
Inventory Management	.137	.140	.913	.367	1.048
Transportation Management	.140	.110	.703	.487	1.077
Information Management	.332	.266	1.741	.090	1.030
R= .343, R Square = .118, Adjusted R Square = .050, F = 1.739, Sig. = .175					

Note: ** p < 0.01, * p < 0.05

To test Hypothesis 4, which posited that "the efficiency of logistics management at Mukdahan Customs Checkpoint is higher than at Chong Mek Customs Checkpoint," an Independent Samples *t*-test was employed to compare the mean efficiency scores between the two locations. The results are presented in Table 6.

Table 6 Comparison of Logistics Efficiency between Mukdahan and Chong Mek Customs Checkpoints

Checkpoint	n	Mean	S.D.	Levene's Test		t-test for Equality of Means		
				F	Sig.	t	df	Sig. (2-tailed)
Chong Mek	43	3.94	0.35	2.103	.150	4.277**	123	.000
Mukdahan	82	3.62	0.43					

Note: p < .01 indicates statistical significance at the 0.01 level; *p < .05* indicates statistical significance at the 0.05 level.

The comparison of efficiency between the two checkpoints using an Independent Samples *t*-test revealed that the mean efficiency at Chong Mek Customs Checkpoint (M = 3.94) was higher than at Mukdahan Customs Checkpoint (M = 3.62). The difference was statistically significant ($t = 4.277$, $df = 123$, $p < .001$). Levene's Test confirmed the homogeneity of variance ($p = .150 > .05$), indicating that the assumption of equal variances was met. Therefore, it can be concluded that the efficiency levels of the two checkpoints differ significantly. However, the result contradicted the initial hypothesis, as Chong Mek was evaluated as more efficient than Mukdahan, leading to the rejection of Hypothesis H4. This finding is particularly noteworthy given that Mukdahan has been positioned—both in infrastructure and policy—as a modern economic gateway along the East–West Economic Corridor.

6. Conclusion, Discussion, and Recommendations

This study aimed to compare the influence of three key logistics management factors— inventory, transportation, and information management—on the efficiency of logistics systems at two border checkpoints: Mukdahan and Chong Mek. The overall analysis ($N = 125$) indicated that all three factors significantly influenced logistics efficiency, with information management exerting the strongest effect. Area-specific analyses revealed that at Mukdahan, all three factors significantly contributed to efficiency, with IT being the dominant driver. By contrast, at Chong Mek, none of the factors were statistically significant, despite high mean scores. Importantly, the *t*-test results showed that efficiency at Chong Mek was rated higher than Mukdahan, contradicting the initial hypothesis.

These findings highlight IT as the main driver of logistics efficiency in modernized border checkpoints such as Mukdahan. This aligns with Zdolsek Draksler et al. (2023), who emphasized the role of real-time information systems in reducing bottlenecks and enhancing transparency, as well as Nguyen et al. (2024), who stressed the impact of digital adoption on cross-border trade efficiency. Mukdahan, as a key gateway of the East–West Economic Corridor (EWEC), illustrates how reliance on e-Customs and the National Single Window enables the effective management of high trade and traffic volumes (Sohaimi & Ishak, 2024).

In contrast, Chong Mek, which primarily facilitates local cross-border trade, did not show significant relationships between the model variables and efficiency. This may be explained by “out-of-model” factors such as personal relationships, regulatory flexibility, and the handling of less complex goods. Such dynamics echo Lesser and Moisé-Leeman (2009), who argued that informal practices continue to shape border trade in many regions. The higher efficiency rating at Chong Mek may therefore reflect users’ lower expectations or the benefits of greater procedural flexibility through informal mechanisms.

Policy implications suggest that Mukdahan should continue to receive sustained investment in IT infrastructure, particularly cross-border integration through a Single Window–to–Single Window approach to enhance efficiency and transparency. By contrast, Chong Mek would benefit more from policies that facilitate small-scale traders, such as the establishment of a One-Stop Service or improvements to basic physical infrastructure, rather than complex IT systems. For practitioners, Mukdahan is recommended for high-value trade requiring transparency and reliability, whereas Chong Mek offers advantages for small traders prioritizing speed and familiarity. Academically, future studies should adopt qualitative methods, such as in-depth interviews, to capture out-of-model factors shaping border performance, and extend comparative research across other checkpoints in Thailand to generate more comprehensive insights.

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